IP5389H

A Power Bank SOC With Integrated Buck-Boost Driver Supporting All Fast Charging Protocol Such As UFCS, 3 Typec PD3.0, Supporting 2~6 Series Batteries And Supporting Maximum Power 100W

1 Feature

- **Supporting Multiple USB Ports Simultaneously**
  - ✧ 2 USB-C input/output ports
  - ✧ 1 USB-C port or USB-A port output
  - ✧ 1 USB-A port output
- **Fast Charging**
  - ✧ Every port supports fast charging
  - ✧ Support QC2.0/QC3.0 output
  - ✧ Support FCP input/output
  - ✧ Support AFC input/output
  - ✧ Support SCP input/output
  - ✧ Support VOOC input/output
  - ✧ Support DRP try.SRC, PD3.0 input/output
  - ✧ Support UFCS
  - ✧ Support BC1.2,Apple
- **Integrated USB PD2.0/PD3.0 Protocol**
  - ✧ Support PD2.0 input/output protocol
  - ✧ Support PD3.0 input/output and PPS output protocol
  - ✧ Support 5V/9V/12V/15V/20V input
  - ✧ Support 5V/9V/12V/15V/20V output
  - ✧ Support adjustable voltage in 20mV/step in PPS Mode
  - ✧ Integrate hardware Bi-phase mark codec (BMC) protocol
  - ✧ Integrate Physical Layer protocol
  - ✧ Integrate hardware CRC
  - ✧ Support Hard Reset
  - ✧ Integrated identification and support for E-MARK cables
- **Power Control**
  - ✧ Integrated bi-directional Buck-Boost NMOS driver
  - ✧ Integrated Charge-Pump to control external NMOS
- **Charge**
  - ✧ Adaptive charging current adjustment
  - ✧ Support 3.65V/4.15V/4.20V/4.30V/4.35V/4.40V battery
  - ✧ Support 2/3/4/5/6 batteries in series
  - ✧ Support charging Lithium Iron Phosphate Battery（3.65V）
- **Boost**
  - ✧ Maximum output power 100W
  - ✧ Up to 97%@5V/2A efficiency with synchronous switching
  - ✧ Support line compensation

- **Battery Level Display**
  - ✧ Integrated 14-bit ADC and coulombmeter
  - ✧ Support 4 LEDs to indicate battery level
  - ✧ Support 88、188 nixie tube
  - ✧ Self-learning coulombmeter, more uniform power display
  - ✧ Support configuring initial battery capacity by external pin
- **Other Functions**
  - ✧ Automatic detection of mobile phone plugging and unplugging
  - ✧ Fast charging status indication
  - ✧ Battery temperature detection
  - ✧ Enter standby mode automatically in light load
  - ✧ Supports multiple key modes
  - ✧ Integrated lighting driver
- **Multiple Protections,High Reliability**
  - ✧ Input overvoltage and undervoltage protection
  - ✧ Output overcurrent, overvoltage, short circuit protection
  - ✧ Battery overcharge, overdischarge, overcurrent protection
  - ✧ IC overtemperature protection
  - ✧ NTC protection for charging and discharging battery
  - ✧ ESD 4kV, input (including CC/DP/DM PINS) withstand voltage 30V
- **Low BOM Cost**
  - ✧ Integrated switch power MOSFET driver
  - ✧ Single inductor for charging and discharging
- **Package Size：8mm × 8mm 0.4Pitch QFN64**

2 Description

IP5389H is a power management SOC that integrates QC2.0/QC3.0/UFCS output fast charging protocol, AFC/FCP/SCP/VOOC input and output fast charging protocol, USB-C PD2.0/PD3.0 input and output fast charging protocol and USB-C PD3.0 PPS output protocol, BC1.2/iPhone protocol, synchronous bi-directional buck-boost converter, lithium battery charging management and battery power indicator, providing a complete power solution for fast charging mobile power supplies. It can support two bidirectional USB C ports, one output USB C (or USB A), and one USB A at the same time and fast charging when any port is connected alone. When two or more output ports are

used at the same time, every port's output voltage is 5V.

Due to the high integration and rich function of IP5389H, only one inductor is needed to realize the bidirectional buck-boost function. Only a few peripheral components are needed in the application, which effectively reduces the size of the overall solution and reduces the BOM cost.

IP5389H supports 2/3/4/5/6 series batteries and the synchronous switch buck-boost system can provide a maximum output capacity of 100W. When there is no load, it automatically enters the dormant state.

IP5389H synchronous switch charging system provides up to 8.0A charging current. The built-in IC temperature, battery temperature and input voltage control loop, intelligently adjust the charging current.

measure battery voltage and current. Built-in power calculation method can accurately obtain battery power information. The battery power curve can be customized to accurately display the battery power.

IP5389H supports 4 LEDs power display, supports 88、188 and other nixie tube power display; Integrated lighting driver; Supports multiple key modes

3 Application Product

- portable power source and energy storage device
- Portable devices such as mobile phones and tablets

IP5389H built-in 14-bit ADC can accurately

Directory

4 Reversion History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

New version release V1.10 (Dec 2023)	**Page**

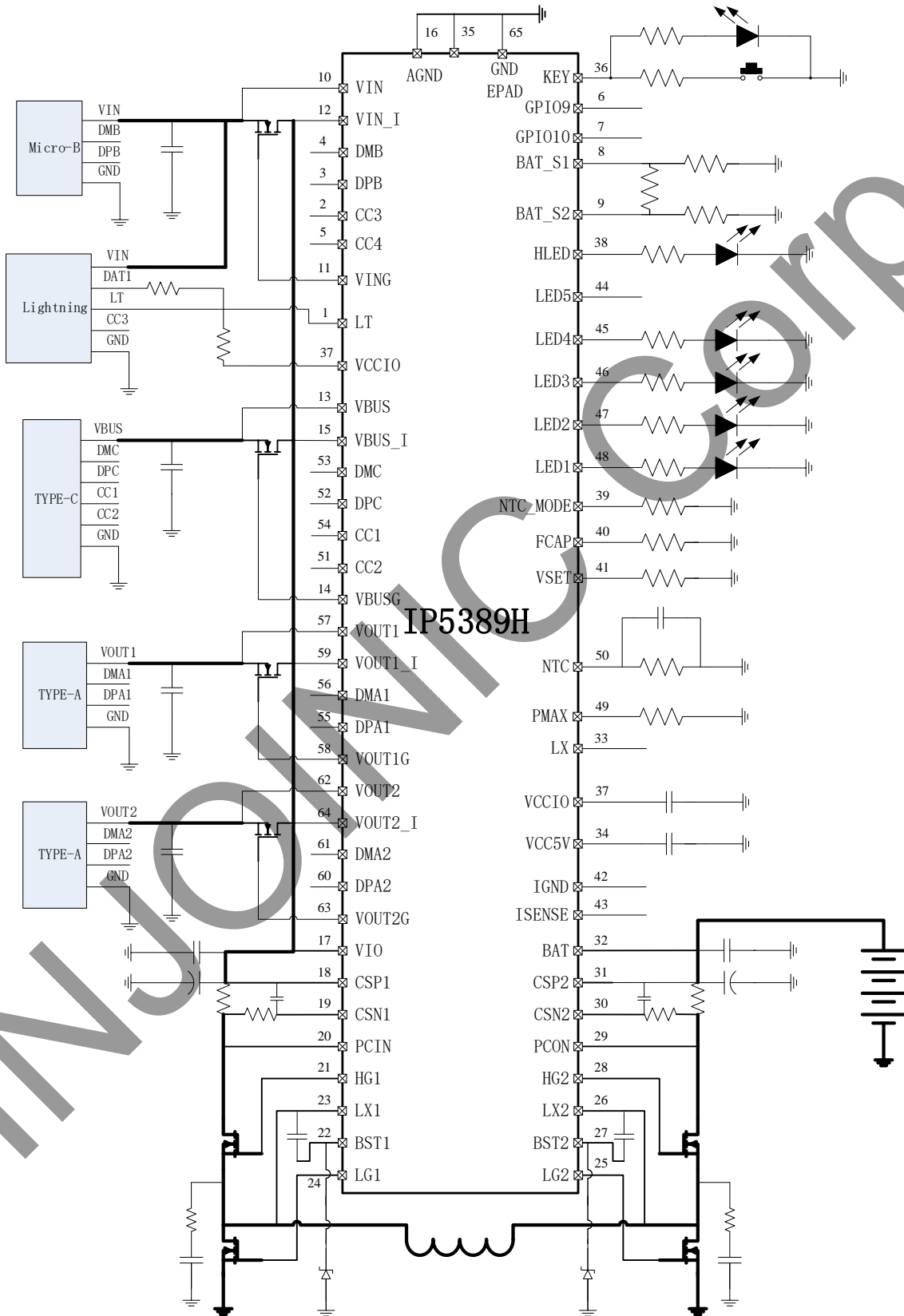# 5 Typical Application

Figure 1   Simplified Application Schematic

6 IP Series Products List

6.1 Power Bank IC

Table 1　Power bank IC table

芯片型号	充放电功率		主要特点								封装	
	放电功率	充电功率	LED灯数	I2C	DCP	USBC	QC认证	PD3.0/PPS	超级快充	UFCS	规格	兼容
IP5303T	5V/1A	5V/1A	1,2	-	-	-	-	-	-	-	ESOP8	PIN2PIN
IP5305T	5V/1A	5V/1A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	PIN2PIN
IP5306	5V/2.4A	5V/2A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	PIN2PIN
IP5306H	5V/2.4A	5V/2A	1,2,3,4	√	-	-	-	-	-	-	ESOP8	PIN2PIN
IP5406T	5V/2.4A	5V/2A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5407	5V/2.4A	5V/2A	1,2,4	-	√	-	-	-	-	-	ESOP8	
IP5108U	5V/2A	5V/2A	3,4,5	√	-	-	-	-	-	-	ESOP16	
IP5109U	5V/2.1A	5V/2A	3,4,5	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5207U	5V/1.2A	5V/1A	3,4,5	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5209U	5V/2.4A	5V/2A	3,4,5	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5207T	5V/1.2A	5V/1A	1,2,3,4	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5189T	5V/2.1A	5V/2A	1,2,3,4	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5189TH	5V/2.1A	5V/2A	1,2,3,4	√	√	-	-	-	-	-	QFN24	PIN2PIN
IP5218	5V/1A	5V/1A	1,2,3,4	-	-	√	-	-	-	-	QFN16	
IP5219	5V/2.4A	5V/2A	1,2,3,4	√	-	√	-	-	-	-	QFN24	
IP5310	5V/3.1A	5V/2.6A	1,2,3,4	√	√	√	-	-	-	-	QFN32	
IP5506	5V/2.4A	5V/2A	NixieTube	-	-	-	-	-	-	-	ESOP16	
IP5508	5V/2.4A	5V/2A	NixieTube	-	√	-	-	-	-	-	QFN32	
IP5320	5V/3.1A	5V/2.6A	NixieTube	√	√	√	-	-	-	-	QFN28	
IP5330	5V/3.1A	5V/2.6A	NixieTube	-	√	√	-	-	-	-	QFN32	
IP5566	5V/3.1A	5V/2.6A	1,2,3,4	-	√	√	-	-	-	-	QFN40	
IP5332	20W	18W	1,2,3,4	√	√	√	√	√	-	-	QFN32	
IP5328P	20W	18W	1,2,3,4	√	√	√	√	√	-	-	QFN40	
IP5353	22.5W	18W	4	√	√	√	√	√	√	-	QFN32	
IP5355	22.5W	18W	4	√	√	Double	√	√	√	-	QFN32	
IP5356	22.5W	18W	NixieTube	√	√	Double	√	√	√	-	QFN40	
IP5358	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN48	
IP5568	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN64	
IP5568U	22.5W	18W	NixieTube	-	√	√	√	√	√	-	QFN64	
IP5385	65W	65W	NixieTube	√	√	Double	√	√	√	√	QFN48	
IP5386	45W	45W	NixieTube	√	√	Double	√	√	√	-	QFN48	
IP5389	100W	100W	NixieTube	√	√	Double	√	√	√	-	QFN64	
IP5389H	100W	100W	NixieTube	√	√	Triple	√	√	√	√	QFN64	

6.2 IP5389H Common Custom Product Description

Table 2　Description of common custom models for IP5389H

| Part No.	function description
IP5389H_S1AACC_BZ	Support 2-6 batteries,support 188 nixie tube, maximum power 100W,support AACC port
IP5389H_LAACC_BZ	Support 2-6 batteries,support LED, maximum power 100W,support AACC port
IP5389H_S1AABC_BZ	Support 2-6 batteries,support 188 nixie tube, maximum power 100W,support AABC port
IP5389H_LAABC_BZ	Support 2-6 batteries,support LED, maximum power 100W,support AABC port
IP5389H_LACCCLO_BZ	Support 2-6 batteries,support LED, maximum power 100W,support A+C+C+CL port

7 Pin Description
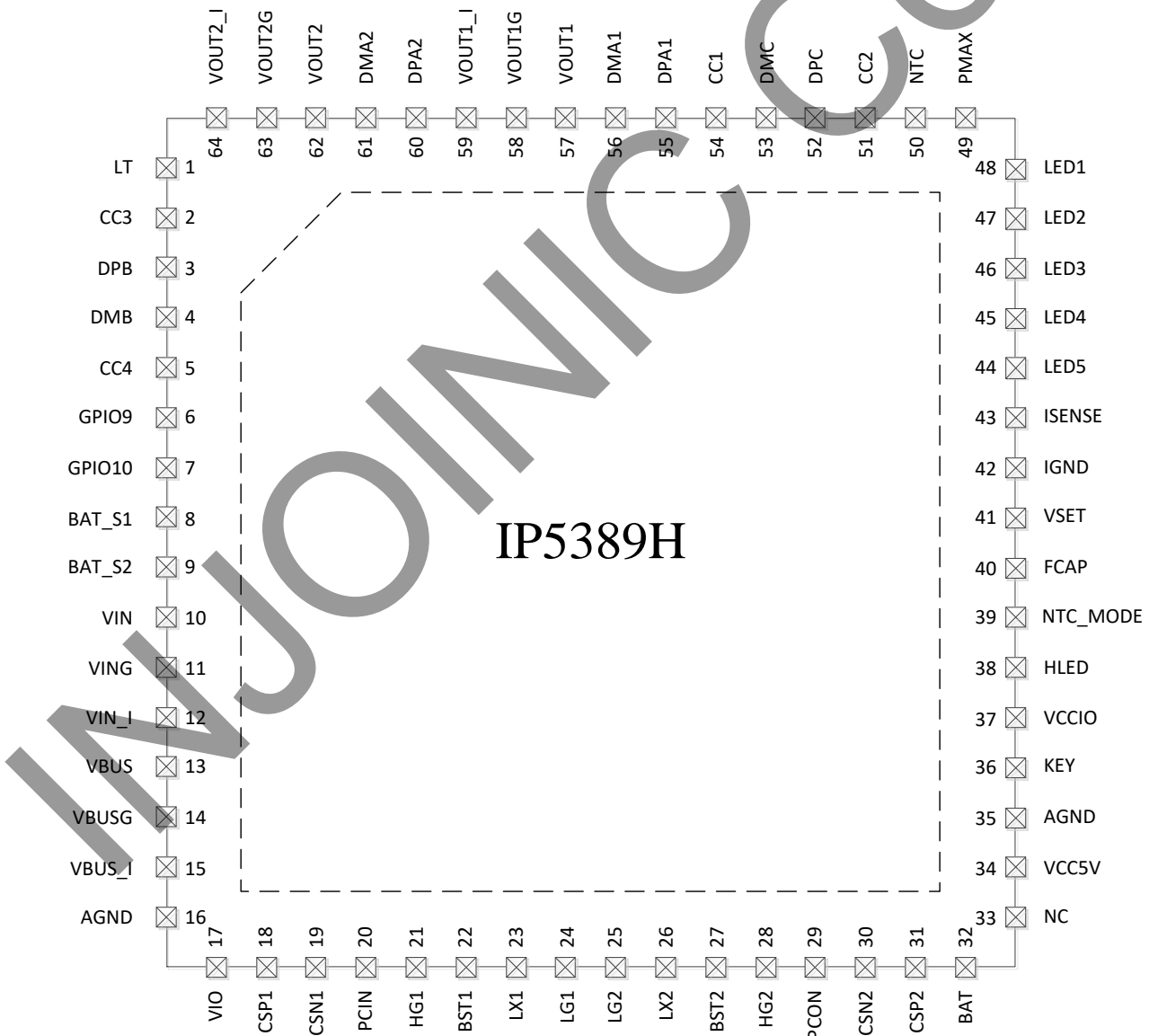
Figure 2   IP5389H Pin Diagram

7.1 IP5389H Pin Description

Table 3   IP5389H pin description

PIN Num	PIN Name	PIN description
1	LT	Lightning decoder pin
2	CC3	USB C2 port detection and fast charge communication pin CC3
3	DPB	MicroUSB fast charge intelligent identification pin DP
4	DMB	MicroUSB fast charge intelligent identification pin DM
5	CC4	USB C2 port detection and fast charge communication pin CC4
6	GPIO9	GPIO
7	GPIO10	GPIO
8	BAT_S1	Number of batteries selected. Grounded or ungrounded, different number of batteries can be selected
9	BAT_S2	Number of batteries selected. Grounded or ungrounded, different number of batteries can be selected
10	VIN	MicroUSB port VIN input charging power pin
11	VING	MicroUSB port input path NMOS control pin
12	VIN_I	MicroUSB port path current detection pin
13	VBUS	USB C port VBUS input/output power pin
14	VBUSG	USB C port input/output path NMOS control pin
15	VBUS_I	USB C port path current detection pin
16	AGND	Analog ground
17	VIO	Mobile power input/output pins
18	CSP1	Input/output current sampling positive end
19	CSN1	Input/output current sampling negative end
20	PCIN	Input/output peak current sampling pin
21	HG1	H-bridge power tube input/output upper tube control pin
22	BST1	H-bridge power tube input/output bootstrap voltage pin
23	LX1	Input/output inductance connecting pins
24	LG1	H-bridge power tube input/output lower tube control pin
25	LG2	H-bridge power tube battery end lower tube control pin
26	LX2	Battery end inductance connects to pin
27	BST2	H-bridge power tube battery end bootstrap voltage pin
28	HG2	H-bridge power tube battery end upper tube control pin
29	PCON	Battery end peak current sampling pin
30	CSN2	Average current at the battery end Sampling negative end

31	CSP2	Battery end current sampling positive end
32	BAT	Battery end power supply pin
33	NC	
34	VCC5V	System 5V power supply, to the IC internal analog circuit power supply
35	AGND	Analog ground
36	KEY	Keys and light pins
37	VCCIO	The 3.3V power supply of the system supplies power to the digital circuit inside the IC
38	HLED	LED model fast charge indicator driver
39	NTC_MODE	Different external resistors can be selected for different NTC functions;
40	FCAP	Battery capacity selection, connect different resistors can choose different battery capacity
41	VSET	Battery voltage selection, connect different resistors can choose different charging battery voltage
42	IGND	Differential current sampling negative end
43	ISENSE	Differential current sampling positive end
44	LED5	Power display light drives LED5
45	LED4	Power display light drives LED4
46	LED3	Power display light drives LED3
47	LED2	Power display light drives LED2
48	LED1	Wake IO
49	PMAX	System input and output maximum power selection, connect different resistors set PMAX
50	NTC	NTC resistance detection pin
51	CC2	USB C port detection and fast charge communication pin CC2
52	DPC	USB C port fast charge intelligent recognition DP
53	DMC	USB C port fast charge intelligent recognition DM
54	CC1	USB C port detection and fast charge communication pin CC1
55	DPA1	USB A1 port fast charge intelligent recognition DP
56	DMA1	USB A1 port fast charge intelligent recognition DM
57	VOUT1	USB A1 port VOUT1 Output power pin
58	VOUT1G	USB A1 port output path NMOS control pin
59	VOUT1_I	USB A1 path current detection pin
60	DPA2	USB A2 port fast charge intelligent recognition DP
61	DMA2	USB A2 port fast charge intelligent recognition DM
62	VOUT2	USB A2 port VOUT2 Output power pin
63	VOUT2G	USB A2 port output path NMOS control pin
64	VOUT2_I	USB A2 path current detection pin

65(EPAD)	GND	Both systemically and thermally, good contact with GND should be maintained

8 Internal Block Diagram of the Chip
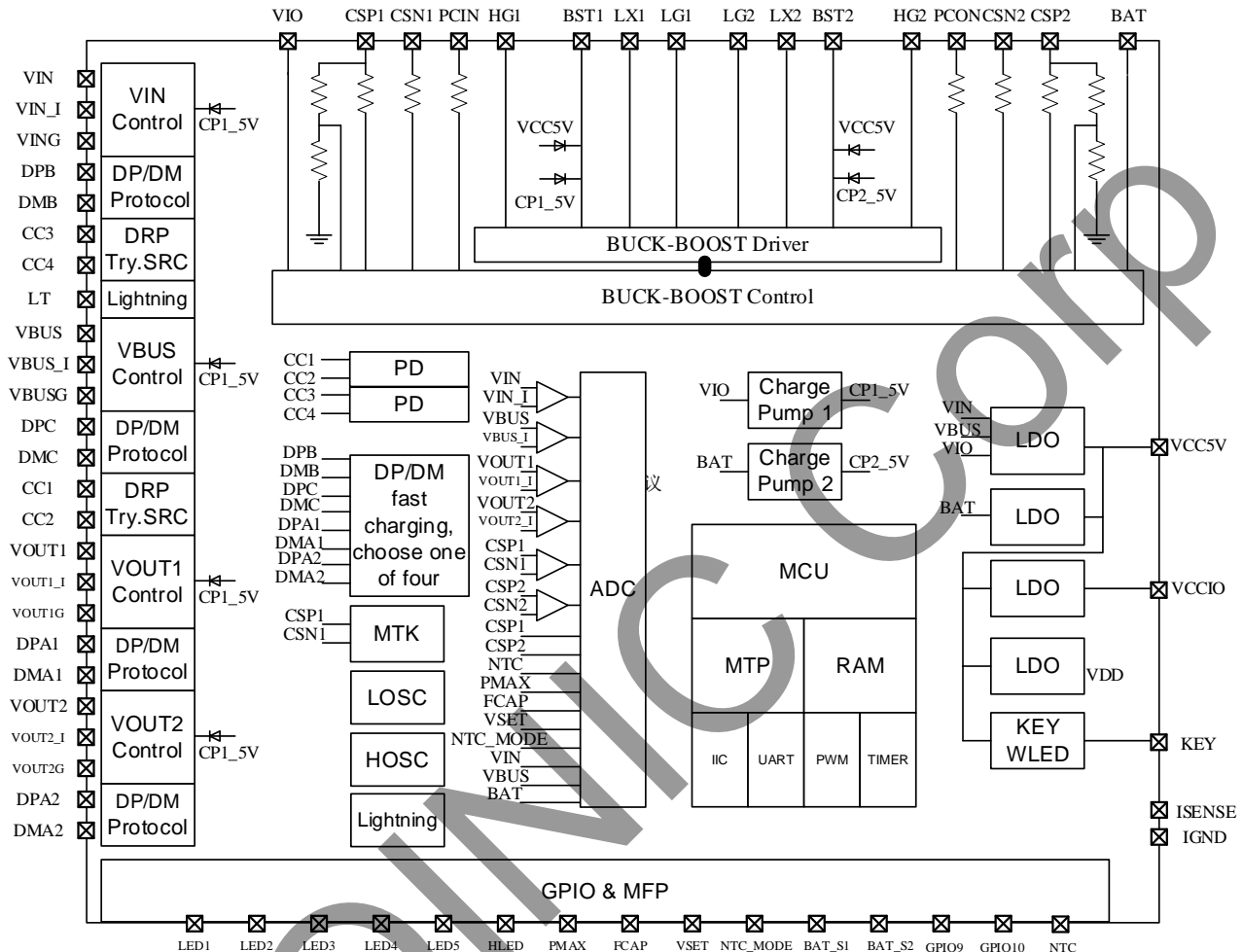
Figure 3   Internal Block Diagram Of The Chip

9 Absolute Maximum Ratings

Table 4   Absolute Maximum Ratings

Parameters	Symbol	Value	Unit
Input Voltage Range	VBAT/VIN/VBUS	-0.3 ~ 30	**V**
Protocol Port Voltage Range	DP/DM/CC	-0.3 ~ 30	**V**
Digital GPIO voltage range	LED/FCAP	-0.3 ~ 8	**V**
Junction Temperature Range	T_J	-40 ~ 125	℃
Storage Temperature Range	Tstg	-60 ~ 150	℃
Thermal Resistance (Junction to Ambient)	θ_{JA}	26	℃/**W**
Human Body Model (HBM)	ESD	4	**KV**

*Stresses higher than the values listed in the Absolute Maximum Ratings section may cause

permanent damage to the device. Excessive exposure under any absolute maximum rating conditions may affect the reliability and service life of the device.

10 Recommended Operating Conditions

Table 5 Recommended Operating Condition

Parameter	Symbol	Min	Typ	Max	Unit
Battery Voltage	VBAT	5.6		30	**V**
Input Voltage	V_{IN}/V_{BUS}	4.5		28	**V**
Output Voltage	$V_{OUT1}/V_{OUT2}/V_{BUS}$	3		28	**V**
Working temperature	T_A	-40		85	℃

* Beyond these operating conditions, device operating characteristics cannot be guaranteed.

11 Electrical Characteristics

Table 6 Electrical characteristics

Unless otherwise specified, TA=25℃, L=10µH

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
		Charging System					
Input voltage	V_{IN}/V_{BUS}			4.5	5/9/12/15/20	25	V
Input overvoltage	V_{IN}					15	V
	V_{BUS}					25	V
Charging constant voltage	V_{TRGT}	The number of battery is N，R_{VSET} = 27kΩ		N*4.16	N*4.20	N*4.24	V
		The number of battery is N，R_{VSET} = 18kΩ		N*4.26	N*4.30	N*4.34	V
		The number of battery is N，R_{VSET} = 13kΩ		N*4.31	N*4.35	N*4.39	V
		The number of battery is N，R_{VSET} = 9.1kΩ		N*4.36	N*4.40	N*4.44	V
		The number of battery is N，R_{VSET} = 6.2kΩ		N*4.11	N*4.15	N*4.19	V
		The number of battery is N，R_{VSET} = 3.6kΩ		N*3.5	N*3.65	N*3.7	V
Charging Current	I_{CHRG}	VIN=5V, input current		1.8	2.0	2.2	A
		VIN=9V, input current		1.8	2.0	2.2	A
		VIN=12V, input current		1.3	1.5	1.7	A
		VBUS=5V, input current		2.7	3.0	3.3	A
		VBUS=9V,PD, input current	PMAX>=27W	2.7	3.0	3.3	A
							A
		VBUS=9V,		1.8	2.0	2.2	A

		Not PD,input current					
		VBUS=12V,PD, input current	PMAX=27W	2.0	2.25	2.5	A
			PMAX=30W	2.2	2.5	2.8	
			PMAX>=45W	2.7	3.0	3.3	
		VBUS=12V, Not PD, input current	PMAX>=27W	1.3	1.5	1.7	A
		VBUS = 15V, PD or Not PD, input current	PMAX=27W	1.6	1.8	2.0	A
			PMAX=30W	1.8	2.0	2.2	
			PMAX>=45W	2.7	3.0	3.3	
		VBUS = 20V, PD, input current	PMAX=30W	1.3	1.5	1.7	A
			PMAX=45W	2.0	2.25	2.5	
			PMAX=60W	2.7	3.0	3.3	
			PMAX=65W	3.0	3.25	3.6	
			PMAX=100W	4.3	4.7	5.1	
		VBUS = 20V, NOT PD, input current	PMAX=30W	1.3	1.5	1.7	
			PMAX=45W	2.0	2.25	2.5	
			PMAX>=60W	2.7	3.0	3.3	
Trickle Charging Current	I_{TRKL}	VIN=5V, VBAT<2.5V		50	100	150	mA
		VIN=5V, 2.5V<=VBAT<N*3.0V		100	200	300	mA
Trickle cut-off voltage	V_{TRKL}	电池节数为 N，V_{TRGT} not 3.65V		N*2.9	N*3	N*3.1	V
	V_{TRKL}	电池节数为 N，V_{TRGT}=3.65V		N*2.7	N*2.75	N*2.85	V
Charging stop current	I_{STOP}			100	0.025*FCAP		mA
Recharging Voltage Threshold	V_{RCH}	The number of battery is N.			$V_{TRGT} - N*0.1$		V
Charging cut-off time	T_{END}			45	48	51	Hour
Boost System							
Battery operation voltage	V_{BAT}	The number of battery is N.		N*2.75		N*4.5	V
Switch working battery input current	I_{BAT}	VBAT=4*3.7V, VOUT=5.0V, Fs=250kHz, Iout=0mA		3	7		mA
DC output voltage	QC2.0 V_{OUT}	V_{OUT}=5V@1A		4.75	5.00	5.25	V
		V_{OUT}=9V@1A		8.70	9	9.30	V
		V_{OUT}=12V@1A		11.60	12	12.40	V

	QC3.0 V_{OUT}	@1A	3.6		12	V
	QC3.0 Step			200		mV
Output voltage ripple	ΔV_{OUT}	VBAT=4*3.7V, VOUT=5.0V, fs=250KHz, Iout=1A		120		mV
		VBAT=4*3.7V, VOUT=9.0V, fs=250KHz, Iout=1A		135		mV
		VBAT=4*3.7V, VOUT=12V, fs=250KHz, Iout=1A		370		mV
Maximum output power of discharge system	Pmax	Under the PD protocol, different PMAX resistance values correspond to different Pmax.	20		100	W
Boost efficiency	η_{out}	V_{BAT}=8V, V_{OUT}=5V, I_{OUT}=2A		94.69		%
		V_{BAT}=8V, V_{OUT}=9V, I_{OUT}=2A		95.36		%
		V_{BAT}=8V, V_{OUT}=12V, I_{OUT}=2A		95.86		%
		V_{BAT}=15V, V_{OUT}=5V, I_{OUT}=2A		91.55		%
		V_{BAT}=15V, V_{OUT}=9V, I_{OUT}=2A		95.05		%
		V_{BAT}=15V, V_{OUT}=12V, I_{OUT}=2A		95.37		%
Boost system shutdown current	I_{shut}	VBAT=N*3.7V,multiple ports output 5V	4.1	4.4	4.7	A
		VBAT= N *3.7V,single port outputs 5V	3.1	3.4	3.8	A
		VBAT= N *3.7V, single port outputs 9V, not under PD protocol condition	2.7	3	3.3	A
		VBAT= N *3.7V, single port outputs 12V, not under PD protocol condition	2	2.2	2.5	A
		VBAT= N *3.7V, single port outputs, under PD protocol condition		PDO * 1.1		A
Shutdown power threshold under light load	P_{out}	VBAT= N*3.7V		350		mW

condition						
Detection time for overcurrent load	T_{UVD}	The output voltage is continuously lower than 2.4V.		30		ms
Detection time for short-circuit load	T_{OCD}	The output voltage is continuously lower than 2.2V.		40		μs
Control System						
Switch frequency	Fs	Discharging switch frequency		250		kHz
		Charging switch frequency		250		kHz
VCCIO output voltage	V_{CCIO}		3.15	3.30	3.45	V
Standby current at the battery terminal	I_{STB}	VBAT=14.8V. The average current after the key is turned off.		100	250	μA
LDO output current	I_{LDO}		25	30	35	mA
The current that drives LED lighting	I_{WLED}		10	15	20	mA
The current that drives LED display	I_{L1} I_{L2} I_{L3}	Voltage decreases 10%.	5	7	9	mA
Detection time for automatic shutdown when total load is light	$T1_{load}$	The load power is continuously less than 350mW.	30	32	34	s
Detection time for automatic shutdown of output port under light load	$T2_{load}$		14	16	18	s
Detection time of short press on key for waking	$T_{OnDebounce}$		60	64	500	ms
The time of opening WLED	$T_{Keylight}$		1.2	2	3	s
Temperature which leads to power off	T_{OTP}	heating	110	125	140	℃
Temperature	ΔT_{OTP}			40		℃

hysteresis after power off							

12 Description of Function

12.1 Lock State and Activation

When the IP5389H is connected to the battery for the first time, no matter what the battery voltage is, the chip is in a lock state, and the lowest digit of the battery indicator will flash 4 times, or the nixie tube 0% will flash 4 times to indicate. When not in the charging state, if the battery voltage is too low, the shutdown will be triggered, and IP5389H will go into lock state at this time.

In the low battery state, in order to reduce static power consumption, IP5389H can't detect the insertion of the load and it can't be activated by pressing the key. At this time, pressing the key can't activate the buck-boost output, but the lowest battery indicator will flash 4 times to prompt.

In the lock state, the chip can be activated only after entering the charging state.

12.2 Charging

IP5389H integrates the constant current and constant voltage lithium battery charging management system with synchronous switch structure, and supports automatic matching of different charging voltage specifications:

When the battery voltage is less than V_{TRKL}, it will apply 200mA trickle charging; When the battery voltage is greater than V_{TRKL}, it will apply constant current charging, and the maximum charging current of the battery terminal is 8.0A; When the battery voltage is close to the setting value, it will apply constant voltage charging; when the battery terminal charging current is less than the stop charging current I_{STOP} and the battery voltage is close to the constant voltage, the charging is stopped. After the charging is completed, if the battery voltage is lower than $(V_{TRGT}-N*0.1)V$, it will restart the battery charging.

IP5389H has switch charging technology with a switching frequency of 250kHz. When charging with ordinary 5V input, the input power is 10W; when charging with fast charging input, the maximum input power is 100W. The charging efficiency can reach 96%, which can shorten the charging time by 3/4.

The IP5389H automatically adjusts the charging current to accommodate adapters with different load capacities.

IP5389H supports simultaneous charging and discharging. When charging and discharging simultaneously, both input and output are 5V.

12.3 Boost

IP5389H integrates a synchronous switching converter system that supports high-voltage output and supports a wide voltage range of 3.0V~21V. The synchronous switching buck-boost system can provide a maximum output capacity of 100W. The built-in soft-start function prevents malfunctions caused by excessive inrush current during start-up.It also has output overcurrent, short circuit, overvoltage, overtemperature and other protective functions to ensure the stable and reliable operation of the system.

The current of the discharging system can be automatically adjusted with the temperature to ensure that the IC temperature is below the set temperature.

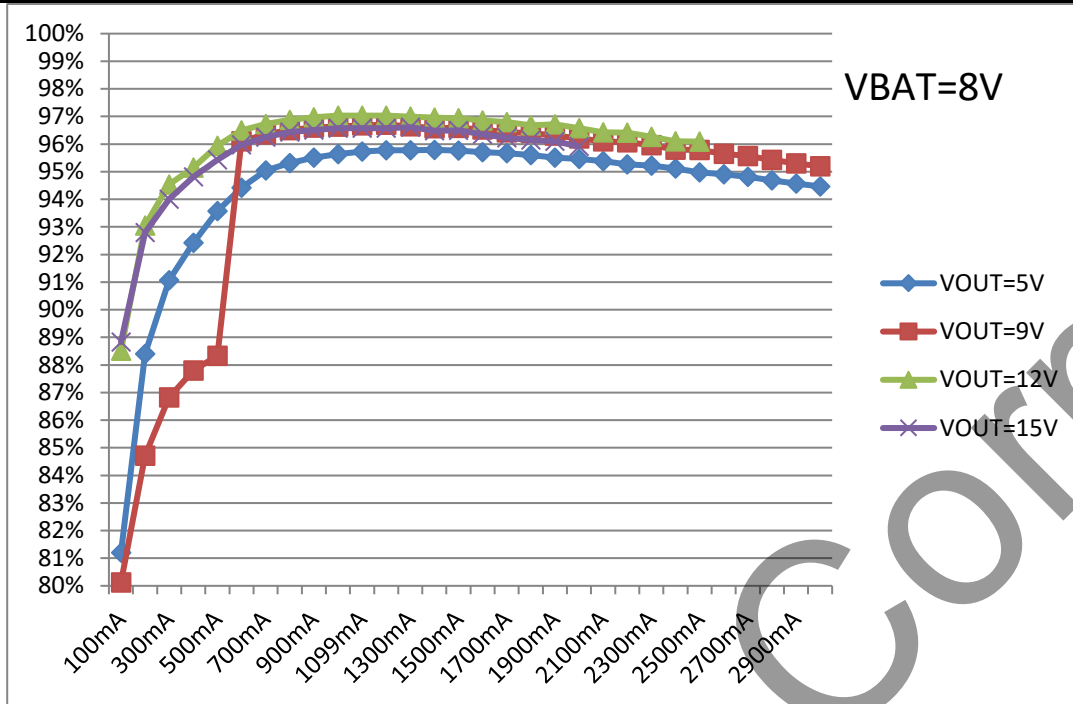VBAT =8V，VOUT=5V/9V/12V/15V，the boost efficiency curve is as follows：

Figure 4   Boost Efficiency Curve Under The Condition Of VBAT=8V

VBAT =15V，VOUT=5V/9V/12V/15V，the boost efficiency curve is as follows：
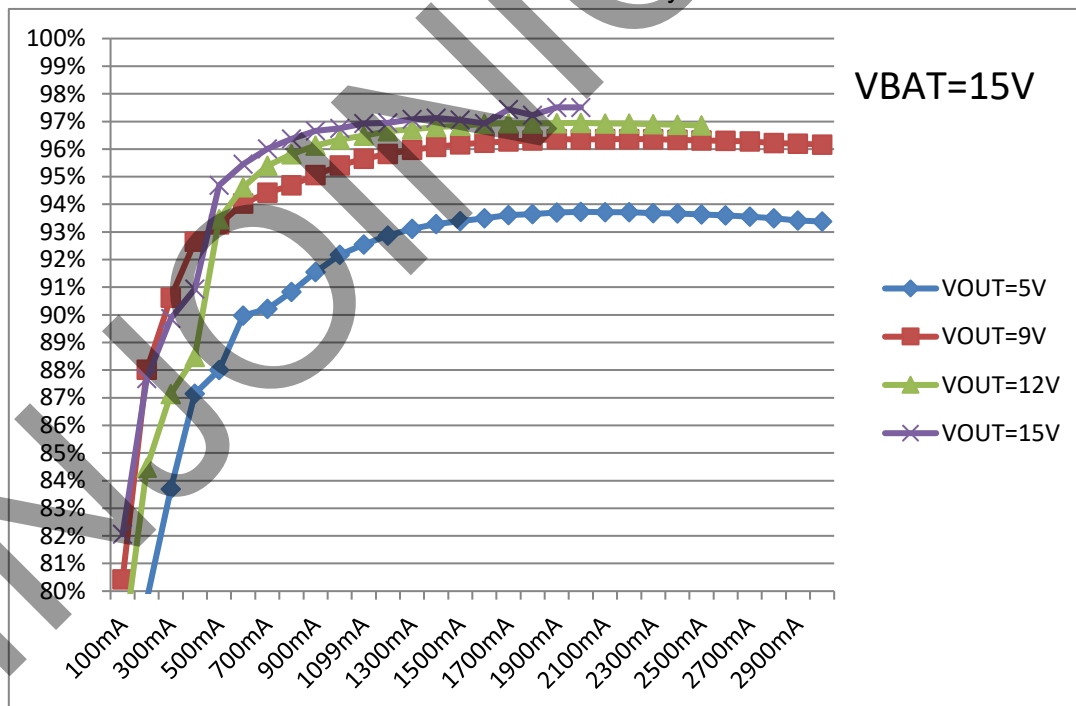

Figure 5   Boost Efficiency Curve Under The Condition Of VBAT=15V

12.4 USB C

IP5389H integrates USB C input and output recognition interfaces, automatically switches the built-in

pull-up and pull-down resistors, and automatically recognizes charging and discharging properties of the inserted device. With Try.SRC function, when the attached device is also DRP device, IP5389H will supply power for the opposite device.

When it works as a DFP, it will output 3A current capability information through CC pin; when it works as a UFP, it can identify the output current capability of the opposite device.

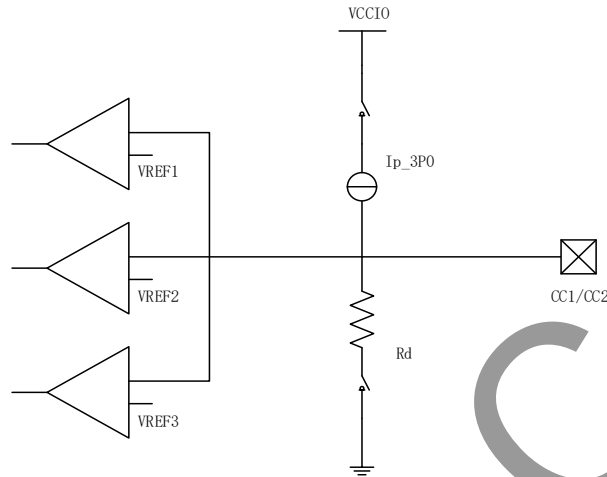Figure 6   CC Internal Circuit

Table 7   Pull-up And Pull-Down Ability

Name	Value
Ip_3P0	330μA
Rd	5.1k

Table 8   Comparator threshold when Ip is enabled

	Minimum Voltage	Maximum Voltage	Threshold
Powered cable/adapter (vRa)	0.00 V	0.75 V	0.80 V
Sink (vRd)	0.85 V	2.45 V	2.60 V
No connect (vOPEN)	2.75 V		

Table 9　Comparator threshold when Rd is enabled

Detection	Min voltage	Max voltage	Threshold
vRa	−0.25 V	0.15 V	0.2 V
vRd-Connect	0.25 V	2.04 V	
vRd-USB	0.25 V	0.61 V	0.66 V
vRd-1.5	0.70 V	1.16 V	1.23 V
vRd-3.0	1.31 V	2.04 V	

Figure 4-36　DRP Timing
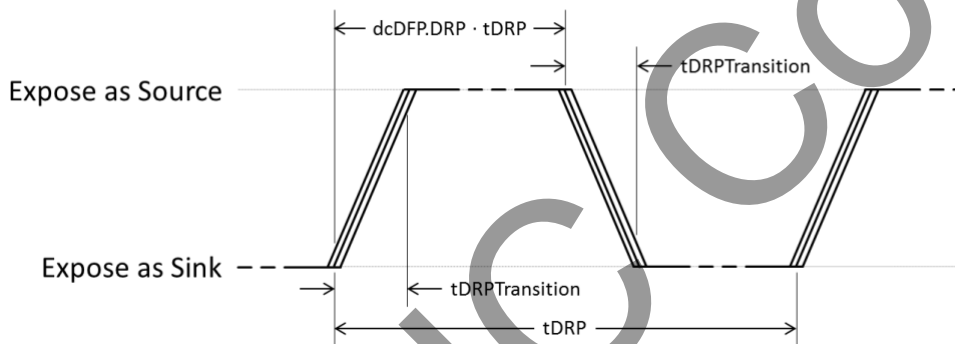
	Minimum	Maximum	Description
tDRP	50 ms	100 ms	The period a DRP shall complete a Source to Sink and back advertisement
dcSRC.DRP	30%	70%	The percent of time that a DRP shall advertise Source during tDRP
tDRPTransition	0 ms	1 ms	The time a DRP shall complete transitions between Source and Sink roles during role resolution
tDRPTry	75 ms	150 ms	Wait time associated with the Try.SRC state.
tDRPTryWait	400 ms	800 ms	Wait time associated with the Try.SNK state.
tTryTimeout	550 ms	1100 ms	Timeout for transition from Try.SRC to TryWait.SNK.
tVPDDetach	10 ms	20 ms	Time for a DRP to detect that the connected Charge-Through VCONN-Powered USB Device has been detached, after VBUS has been removed.

Table 10　USB C detection period
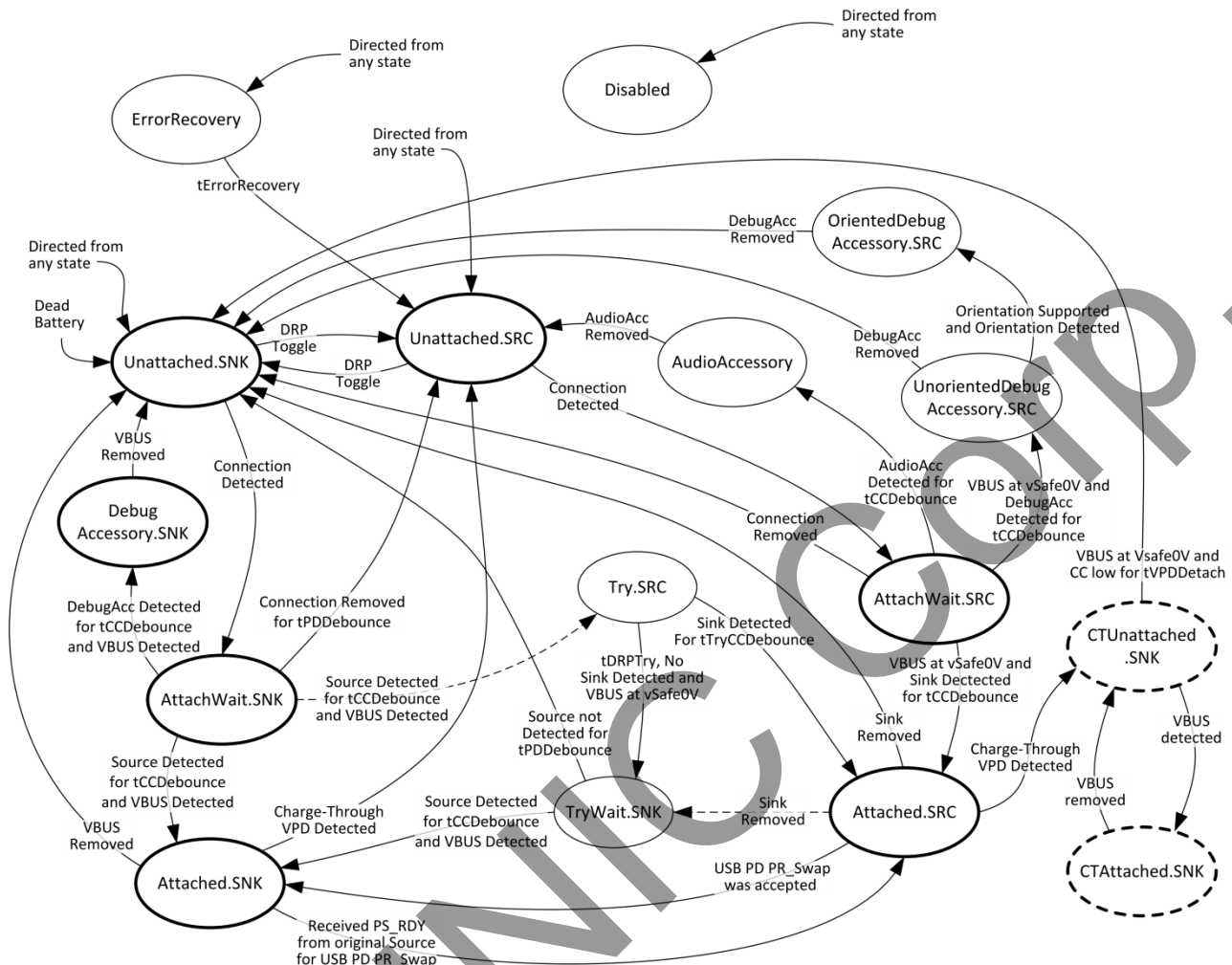
Figure 7　　USB-C Detects State Transitions

12.5 USB C PD

IP5389H integrates USB C Power Delivery PD2.0/PD3.0/PPS (Programmable Power Supply) protocol,physical (PHY) layer for data transmitting receiving across the CC wire.Hardware biphase mark coding (BMC) module and E-mark identification module.

IP5389H supports PD2.0/PD3.0 bidirectional input/output protocol and PPS output protocol. The maximum output power is 100W.Input voltage gears includes 5V, 9V, 12V, 15V, 20V.Output voltage gears includes 5V, 9V, 12V, 15V, 20V. When recognizing the E-MARK cable, the output broadcast capability is 5V/3A，9V/3A，12V/3A，15V/3A，20V/5A，PPS 3.3~21V/3A; When the E-MARK cable is not recognized, the output broadcast capability is 5V/3A，9V/3A，12V/3A，15V/3A，20V/3A，PPS 3.3~21V/3A.

12.6 Fast Charging Protocol

IP5389H supports multiple fast charging protocols: QC2.0、QC3.0、FCP、AFC、SCP、VOOC、Apple、UFCS.

When the mobile power bank charges the mobile power bank, It does not support QC2.0, QC3.0

functions, does not support external fast charge protocol ics.

Charging the mobile power bank can support FCP and AFC fast charge input, because FCP and AFC are fast charge handshake requests through DP/DM, so when other fast charge protocol ics are added, FCP and AFC fast charge can no longer be supported

When the mobile power bank charges the mobile phone, it will automatically detect the fast charging sequence on the DP and DM PINs after entering the discharge mode, and intelligently identify the type of mobile phone，which support QC2.0/QC3.0, FCP, AFC, SCP、VOOC protocol, Apple 2.4A mode, BC1.2 ordinary 1A mode.

For Apple 2.4A mode: DP=DM=2.7V.

For BC1.2 mode: DP short to DM.

In the BC1.2 mode, when the DP voltage is detected to be greater than 0.325V and less than 2V for 1.25s, the initial judgment is that there is a fast charging request. At this time, the short circuit between DP and DM will be disconnected, and DM will be pulled down to ground by a 20kΩ resistor. If it is satisfied that the DP voltage is greater than 0.325V and less than 2V, and the DM voltage is less than 0.325V for 2ms, the fast charging connection is considered successful. After that, the requested voltage can be output according to the requirements of QC2.0,QC3.0. As long as the DP voltage is less than 0.325V, the fast charge mode is forced to exit, and the output voltage immediately returns to the default 5V.

Table 11   QC2.0,QC3.0 Rules For Requesting Output Voltage

DP	DM	Result
0.6V	GND	5V
3.3V	0.6V	9V
0.6V	0.6V	12V
0.6V	3.3V	Continuous Mode
3.3V	3.3V	hold

Continuous Mode is the unique working mode of QC3.0. In this mode, the output voltage can be adjusted in a 200mV step according to the QC3.0 protocol requirements.

Table 12   The Fast Charging Protocol Supported By Each Port Of IP5389H

Protocols	VOUT1 Output	VOUT2 Output	Lightning Input	TYPEC Output	TYPEC Input
QC2.0	√	√	-	√	-
QC3.0	√	√	-	√	-
QC3+	-	-	-	-	-
AFC	√	√	-	√	√
FCP	√	√	-	√	√
SCP	√	√	-	√	-
VOOC	√	√	-	-	-
PD2.0	-	-	√	√	√
PD3.0	-	-	√	√	√

PPS	-	-	-	√	-
UFCS	√	√	-	√	-

supported：√

not supported：-

12.7 Charging and Discharging Path Management

12.7.1 Standby:

If VIN or VBUS is connected to a power supply, charging can be started directly.

If a USB-C UFP device is inserted into USB-C or an electrical device is inserted into VOUT, the discharging function can be automatically turned on.

IP5389H will turn on when the key is pressed and there is a load on VOUT1, VOUT2, or USB-C, otherwise it will keep standby state.

12.7.2 Discharging:

When the key is not pressed, only the path of the output port that is connected to electrical device will be opened, and the path of the output port that is not connected to electrical device will be closed.

Any port of VOUT1, VOUT2, USB-C can support output fast charging protocol, because of a single inductor solution, it can only support one voltage output. In other words, It only supports fast charging output when only one output port is turned on. When two or three output ports are used at the same time, the fast charging function will be automatically turned off.

According to the connection shown in the "Simplified application schematic", when any output port has entered fast charging output mode, if another output port is plugged in with an electrical device, it will first close all the output ports, turn off the high-voltage fast charge function, and then turn on the output port where the device exists. At this time, all the output ports only support Apple and BC1.2 charging. When in the multi-port output mode, if the output current of any output port is less than about 80mA (MOS Rds_ON@10ohm), the port will be automatically closed after 16s. When it is detected that the number of electrical device is reduced from multiple to one, after about 16s, all output ports will be closed first, then the high-voltage fast charging function will be turned on, and the output port connected to the electrical device will be turned on. In this way, the device can be reactivated to request a fast charging. When only one output port is turned on, and total output power is less than about 350mW for about 32s, IP5389H will close the output port, stop discharging and enter standby state.

12.7.3 Charging:

Any one of VIN and VBUS can be plugged into a power source to charge the battery. If they are all connected to the power source, the first plugged-in power source will be used first for charging.

In single-port charging mode, it will automatically recognize the fast charging mode of the power supply and automatically match the appropriate charging voltage and charging current.

12.7.4 Charge while discharging

When the charging power supply and the electrical device are plugged in at the same time, the chip will automatically enter the charging and discharging mode. In this mode, it will automatically close the internal fast charging input request. When the VIO voltage is only 5V, the discharging path is opened to

supply power to the electrical device; if the VIO voltage is greater than 5.6V, for safety reasons, the discharging path will not be opened. In order to charge the electrical device normally, IP5389H will increase the charging undervoltage loop to above 4.925V to ensure that the electrical device is given priority to supply power.

During the charging and discharging process, if the charging power is unplugged, IP5389H will turn off the charging and restart discharging to supply power to the electrical device. For safety reasons, and to reactivate the mobile phone to request fast charging, the voltage will drop to 0V for a period of time during the conversion process.

During the charging and discharging process, if the electrical device is unplugged, or the electrical device is fully charged and stops drawing power, the corresponding discharging path will be automatically closed after about 16s. When the discharging paths are closed and the state returns to the charging only mode, the charging undervoltage loop will be lowered and the fast charging will be automatically reactivated, then the charging of the mobile power supply will be accelerated.

12.8 Automatic Detection for Mobile Phone

12.8.1 Automatic detection for mobile phone insertion

If an inserted phone has been automactically detected by IP5389H, IP5389H will wake up from standby state immediately and turn on the boost 5V to charge the phone. This design can save the step of turning on the key and support the mold scheme without key.

12.8.2 Automatic detection for fully charged mobile phone

IP5389H samples the output current of each port through the on-chip ADC. When the output current of a single port is less than about 80mA (MOS Rds_ON@10mohm) and lasts for about 16s, the output port will be closed. When the total output power is less than about 350mW and lasts for about 32s, it is considered that the mobile phones of all output ports are fully charged or unplugged, and the buck-boost output will be automatically turned off.

12.9 Key Function

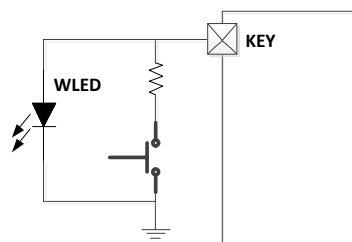Figure 8   Key Circuit

Key circuit is illustrated in Figure 8, which can recognize short press or long press operation.

- Pressing the key for longer than 60ms but less than 2s is a short press action.
- Pressing the key for longer than 2s is a long press action.
- There will be no response when the key is pressed for less than 60ms.
- Pressing the key for longer than 10s to reset the entire system.

12.10 Fast Charging Status Indicator

HLED is used to indicate the current fast charging mode. Regardless of charging or discharging, the indicator will automatically light up when entering the fast charging mode and in a non-5V state.

It can be used as the 6pin drive pin of the 6pin nixie tube scheme, and there is no fast charging lamp display (need to be customized according to the actual nixie tube specifications).
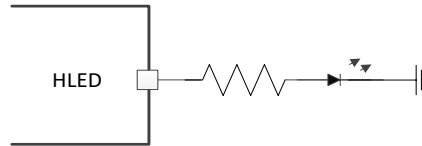

Figure 9   Fast Charging State Indication

12.11 Coulombmeter and Battery Level Display

IP5389H has a built-in coulombmeter, which can realize accurate battery power calculation.

IP5389H supports 4-LED mode.

IP5389H supports 188 nixie tube to display power.

Note: The IP5389H solution only supports the choice of 188 nixie tube and LED, and cannot select 188 nixie tube and LED lamp through the external resistance pin.

12.11.1 Coulombmeter

IP5389H supports externally setting the initial capacity of the battery, and uses the integral of the current and time of the battery terminal to manage the remaining capacity of the battery. When a 5 mΩ detection resistor is used between the battery current detection pins CSP2 and CSN2, the current battery capacity can be accurately displayed. When Pin CSP2/CSN2 is short-circuited, it can estimate the battery current to display the estimated current cell capacity.IP5389H supports the automatic calibration of the total capacity of the current battery in a complete charging process from 0% to 100%, and more reasonable management of the actual capacity of the battery.

IP5389H sets the system battery capacity by determining external pin: battery capacity=R17 * 0.8(mAH). The minimum supported capacity is 2000mAH, and the maximum supported capacity is 25000mAH, which is the capacity of a single battery.

When the voltage on the FCAP pin is less than 100mV or greater than 2700mV, the R17 resistor recognizes a short circuit or open circuit state.
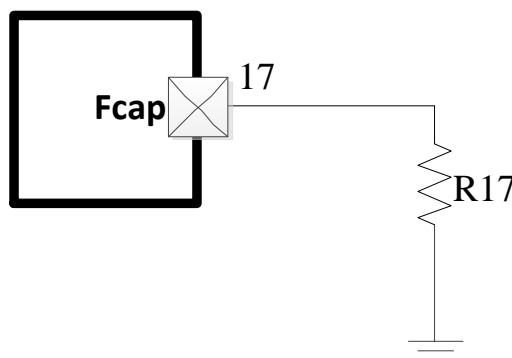
Figure 10   Battery Capacity Configuration Circuit

Table 13   Typical battery capacity configuration table

R17 resistance value (ohm)	Corresponding to the set cell capacity (mAH)
6.2k	5000mAH
12.4k	10000mAH
18.7k	15000mAH
24.9k	20000mAH
30.9k	25000mAH

Note: The cell capacity in the table refers to the cell capacity of a single battery.

12.11.2 LED Power Display Mode

IP5389H 4/2/1-LED mode to display the capacity of the battery is as follows:

Figure 11   4/2/1-LED Connection

Table 14　Charging Lamp Display of 4-LED mode

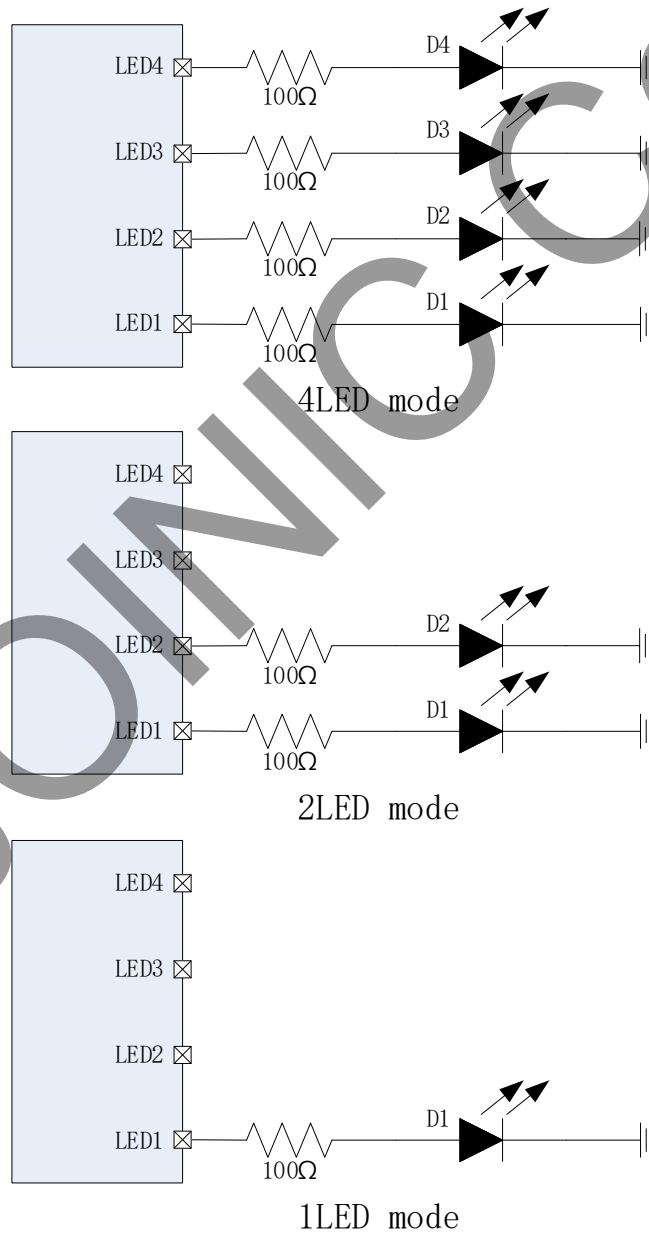| Battery capacity C(%)	D1	D2	D3	D4
Fully charged	ON	ON	ON	ON
75%≤C	ON	ON	ON	1.5Hz Flash
50%≤C＜75%	ON	ON	1.5Hz Flash	OFF
25%≤C＜50%	ON	1.5Hz Flash	OFF	OFF
C＜25%	1.5Hz Flash	OFF	OFF	OFF

Table 15　Discharging Lamp Display of 4-LED mode

Battery capacity C(%)	D1	D2	D3	D4
C≥75%	ON	ON	ON	ON
50%≤C＜75%	ON	ON	ON	OFF
25%≤C＜50%	ON	ON	OFF	OFF
3%≤C＜25%	ON	OFF	OFF	OFF
0%＜C＜3%	1.0Hz Flash	OFF	OFF	OFF
C=0%	OFF	OFF	OFF	OFF

12.11.3 188 Nixie Tube Display Mode

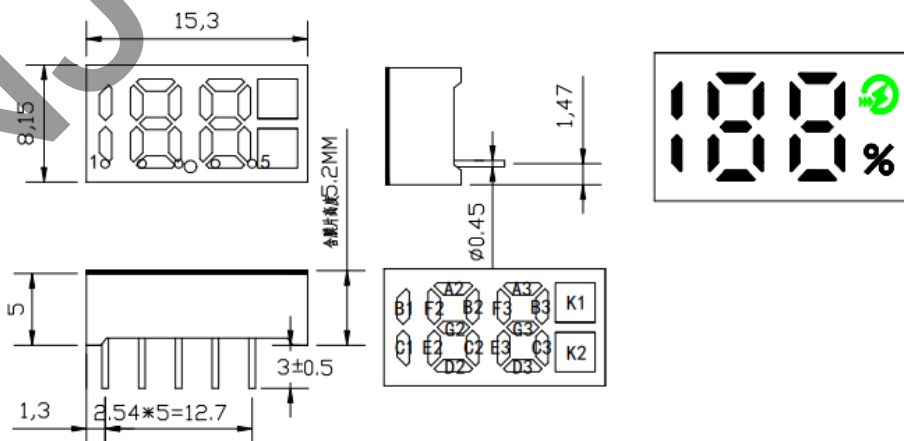The nixie tube supported by IP5389H is as follows:

Table 16　Nixie Tube Display Mode

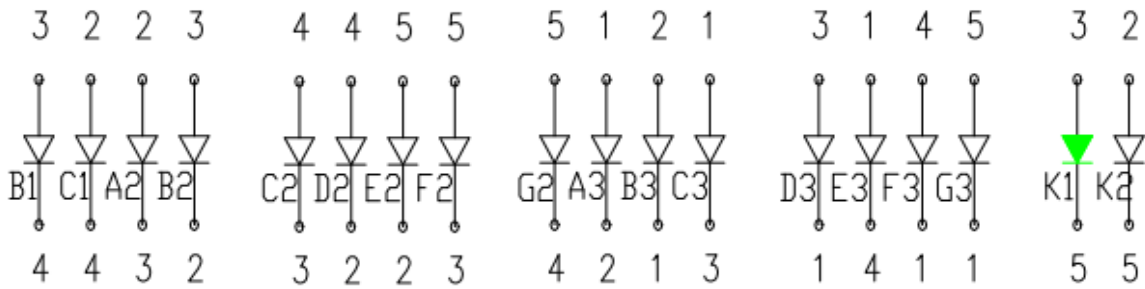| Nixie Tube	During charging		During discharging	
	Not fully charged	Fullly charged	Battery capacity <5%	Battery capacity>5%
188	0-99% ones place 0.5Hz Flash	100% always on	0-5% ones place 1Hz Flash	5%-100% always on

(未注尺寸公差 Unspecified Tolerances is：±0.2　发光颜色：白色、翠绿

Figure 12   5-PIN 188 Nixie Tube Circuit

Table 17   IP5389H light display drive pin and digital tube pin pin sequence mapping relationshipNixie Tube Display Mode

IP5389H light display driver pin	Digital tube pin	Remarks
LED1(48 pin)	1 pin	
LED2(47 pin)	2 pin	
LED3(46 pin)	3 pin	
LED4(45 pin)	4 pin	
LED5(44 pin)	5 pin	
HLED(38 pin)	6 pin	Customizable 6pin nixie solution

12.12 Setting the System Input/Output Maximum Power

IP5389H sets the maximum input and output power of the system by judging the resistance value connected to the PMAX PIN.

Table 18   The table of input and output maximum power configuration

PMAX R14（ohm 1%）	Corresponding to the set maximum power PMAX
33k	100W（ The output power of an E-MARK cable is 100W ）
27k	65W（ The output power of an E-MARK cable is 65W ）
18k	60W
13k	45W
9.1k	35W
6.2k	30W
3.6k	27W

Note: IP5389H integrated E-MARK cable identification circuit

12.13 Setting the Number of Batteries in Series

IP5389H sets the number of batteries in series by judging whether the BAT_S1 and BAT_S2 pins are connected to GND, so as to change the power display threshold, constant voltage to charge the battery and protection voltage.

Table 19   The table of number of batteries in series configuration

BAT_S1 R18(ohm)	BAT_S2 R19(ohm)	Number of batteries in series
0	0	2 series
NC	0	3 series
0	NC	4 series
NC	NC	5 series
BAT S1 and BAT S2 are short-circuited through 0R		6 series

12.14 VSET(Battery Type Setting)

IP5389H sets the battery type by outputting 80µA current to the different resistor connected to GND on the VSET PIN, thereby changing the battery display threshold, the constant voltage for charging the battery, and the protection voltage. The different resistances to GND connected to VSET PIN and the corresponding different battery types are shown in the following table. Note that the external resistor should use a 1% precision resistor, and the resistance selection needs to take into account the voltage of the VSET in the middle of the judgment range as far as possible.When the voltage of VSET PIN exceeds all judgment ranges, the chip will recognize the circuit as a short circuit or an abnormal open circuit.

Table 20　Battery charging voltage configuration table

Resistance from VSET to GND(ohm)	VSET Voltage (Theoretical Voltage)	VSET Voltage Judgment Range(mV)	Corresponding Battery Type
27k	2160	1750~2550	4.2V
18k	1440	1220~1750	4.3V
13k	1040	860~1220	4.35V
9.1k	728	600~860	4.4V
6.2k	496	384~600	4.15V
3.6k	288	216~384	3.65V

Note: 3.65V refers to lithium iron phosphate battery and corresponding turn-off voltage is 2.75V.

12.15 NTC Function and Threshold Selection

IP5389H integrates NTC function, which can detect battery temperature. When the IP5389H is working, the NTC PIN outputs 80uA current at high temperatures and 20uA current at low temperatures and an external NTC resistor is used to generate a voltage.The IC internally detects the voltage of the NTC pin to determine the current battery temperature.

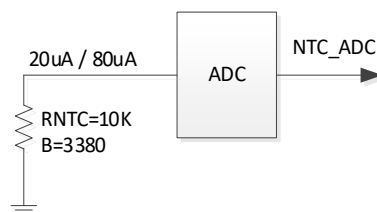

Figure 13　Battery NTC comparison

IP5389H discharges 80µA current on the NTC_MODE PIN. If this PIN is connected with different resistors, different voltages can be obtained. The IC will detect the NTC_MODE voltage and select different

NTC functions according to the NTC_MODE PIN voltage. Note that the external resistor should use a 1% precision resistor, and the resistance selection needs to take into account the voltage of the NTC_MODE PIN in the middle of the judgment range as far as possible.When the voltage of NTC_MODE PIN exceeds all judgment ranges, the chip will recognize the circuit as a short circuit or an abnormal open circuit.
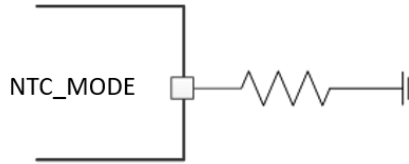

Figure 14   NTC Threshold Selection

Table 21   The table of NTC function configuration

NTC_MODE pin Resistance	NTC_MODE pin Theoretical Voltage	NTC_MODE pin Voltage Judgment Range	NTC Function
3.6K	288	216~380	NTC first gear
6.2K	496	380~600	NTC second gear
9.1K	728	600~860	NTC third gear
13K	1040	860~1220	NTC fourth gear
18K	1440	1220~1750	NTC fifth gear
27K	2160	1750~2550	NTC sixth gear

IP5389H has six built-in NTC functions. By changing the resistance between MTC_MODE PIN and GND, the corresponding NTC function can be set. The functions are as follows:

NTC first gear:

In the charging state,charging stops when the NTC temperature is lower than 0°C (0.55V), normal charging between 0 and 45°C, and charging stops when the NTC temperature is higher than 45°C (0.39V).

In the discharge state,discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 60°C, and the discharge is stopped when the NTC temperature is higher than 60°C (0.24V).

NTC second gear:

In the charging state, charging stops when the NTC temperature is lower than 2°C (0.50V), normal charging between 2°C and 43°C, and charging stops when the NTC temperature is higher than 43°C (0.42V).

In the discharge state, discharge is stopped when the NTC temperature is lower than -10°C (0.86V), normal discharge is between -10°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC third gear:

In the charging state, charging stops when the NTC temperature is lower than 0°C (0.55V), normal charging between 0 and 45°C, and charging stops when the NTC temperature is higher than 45°C (0.39V).

In the discharge state, discharge is stopped when the NTC temperature is lower than -10°C (0.86V), normal discharge is between -10°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC fourth gear:

In the charging state, when the NTC temperature is lower than -10°C (0.86V), the charging stops, the current limit of the BAT terminal is 0.2C between -10°C ~0°C, and C is equal to the battery capacity set by FCAP, and the normal charging is between 0°C and 45°C (0.39V). Between 45°C and 55°C, the constant voltage charging voltage is reduced by 0.1V*N to charge the battery with normal current, and the NTC temperature is higher than 55°C (0.28V) to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

NTC fifth gear:

In the charging state, when the NTC temperature is lower than 2°C (0.50V), the charging stops, the current limit of the BAT terminal is 0.1C between 2°C and 17°C(0.27V), and C is equal to the battery capacity set by FCAP, and the normal charging is between 17 and 43°C(0.42V) and the NTC temperature is higher than 43°C (0.42V) to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 60°C, and the discharge is stopped when the NTC temperature is higher than 60°C (0.24V).

NTC sixth gear:

In the charging state, When the NTC temperature is lower than -10°C (0.86V), the charging stops, the current limit of the BAT terminal is 0.2C between -10°C and 0°C (0.55V),and the charging is normal between 0 °C and 45°C. the BAT terminal current is limited to 0.2C for charging between 45°C ~55°C (0.28V), C is equal to the battery capacity set by FCAP, and the NTC temperature is higher than 55℃ (0.28V) to stop charging.

In the discharge state, discharge is stopped when the NTC temperature is lower than -20°C (1.39V), normal discharge is between -20°C and 55°C, and the discharge is stopped when the NTC temperature is higher than 55°C (0.28V).

*Note:

After detecting the abnormal temperature of the NTC, it resumes normal operation when the temperature is ±5 degrees Celsius of the protection temperature. In the brackets after the above temperature, the NTC PIN voltage corresponding to the temperature is written. The calculation method is: the current discharged by the NTC PIN * the NTC resistance value at the temperature.

The NTC resistance parameter referenced in the above temperature range is 10kΩ@25℃ B=3380. Other models are different and need to be adjusted.If the scheme does not require NTC, the NTC pin should be connected to the ground with a 10kΩ resistor, and cannot be left floating or grounded directly.

13 Application Schematic

注意：如果方案上同时有B口和Lightning口，双口不能同时插入，需要在模具上做限制

R20 (欧姆)	BAT_S1 R18 (欧姆)	BAT_S2 R19 (欧姆)	电池串联节数
NC	0	0	2串
NC	NC	0	3串
NC	0	NC	4串
NC	NC	NC	5串
0R	NC	NC	6串

VSET R16 (欧姆 1%)	对应电池类型
27k	4.2V
18k	4.3V
13k	4.35V
9.1k	4.4V
6.2k	4.15V
3.6k	3.65V 支持磷酸铁锂电池

PMAX R24 (欧姆 1%)	对应设定的最大功率PMAX
33k	100W
27k	65W
18k	60W
13k	45W
9.1k	35W
6.2k	30W

FCAP R17 (欧姆 1%)	对应设定的电芯容量 (mAH)
Qmax/800	Qmax
6.2k	5000mAH
12.4k	10000mAH
18.7k	15000mAH
24.9k	20000mAH
30.9k	25000mAH

R7	NTC模式选择
27k	六档
18k	五档
13k	四档
9.1k	三档
6.2k	二档
3.6k	一档（默认）

不使用NTC时，NTC pin脚10K接地

IP5389H U1

H桥NMOS

Figure 15　AABC Application Schematic Diagram

Figure 16 ACCCLO Application Schematic Diagram

R20 (欧姆)	BAT_S1 R18 (欧姆)	BAT_S2 R19 (欧姆)	电池串联节数
NC	0	0	2串
NC	NC	0	3串
NC	0	NC	4串
NC	NC	NC	5串
0R	NC	NC	6串

VSET R16 (欧姆 1%)	对应电池类型
27k	4.2V
18k	4.3V
13k	4.35V
9.1k	4.4V
6.2k	4.15V
3.6k	3.65V 支持磷酸铁锂电池

PMAX R24 (欧姆 1%)	对应设定的最大功率PMAX
33k	100W
27k	65W
18k	60W
13k	45W
9.1k	35W
6.2k	30W

FCAP R17 (欧姆 1%)	对应设定的电芯容量 (mAH)
Qmax/800	Qmax
6.2k	5000mAH
12.4k	10000mAH
18.7k	15000mAH
24.9k	20000mAH
30.9k	25000mAH

R7	NTC模式选择
27k	六档
18k	五档
13k	四档
9.1k	三档
6.2k	二档
3.6k	一档（默认）

不使用NTC时，NTC pin脚10K接地
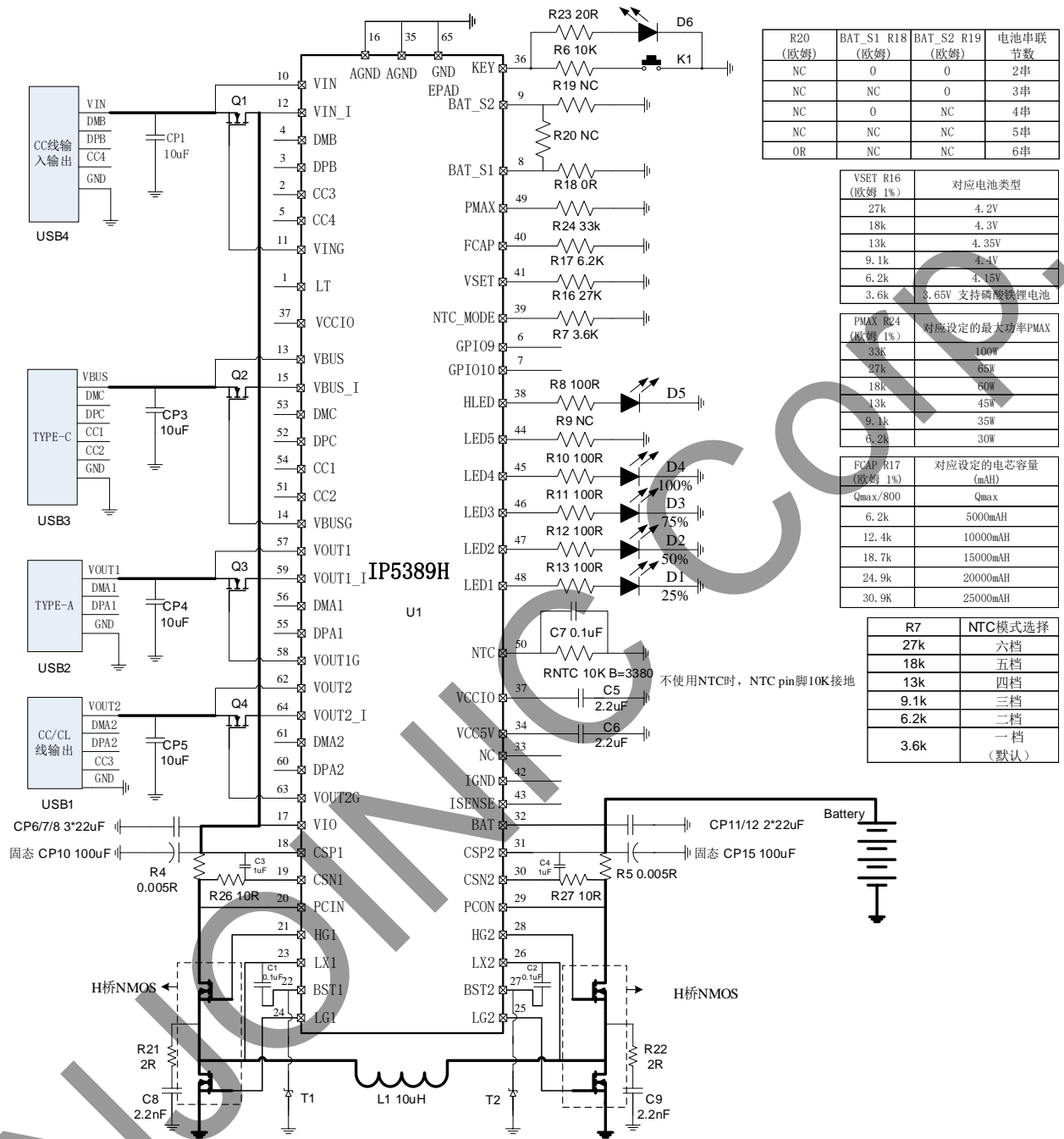
14 BOM

Table 22   IP5389H Application schematic BOM

Serial number	Part name	Type	Location	Number	Remarks
1	SMT IC	QFN64 IP5389H	U1	1	
2	SMT capacitor	0603 100nF 10% 50V	C1 C2 C7	3	
3	SMT capacitor	0603 1uF 10% 16V	C3 C4	2	
4	SMT capacitor	0603 2.2uF 10% 16V	C8 C9	2	
5	SMT capacitor	0805 10uF 10% 25V	CP1 CP3 CP4 CP5	4	
6	SMT capacitor	0805 22uF 10% 25V	CP6 CP7 CP8 CP11 CP12	5	
7	CPAE capacitor	100uF 35V 10%	CP10 CP15	2	
8	SMT resistor	1206 0.005R 1%	R4 R5	2	
9	SMT resistor	0603 10K 5%	R6	1	
10	SMT resistor	0603 27K 1%	R16	1	
11	SMT resistor	0603 6.2K 1%	R17	1	
12	SMT resistor	0603 0R 1%	R18	1	
13	NTC thermal resistor	10K@25℃ B=3380	RNTC	1	
14	SMT resistor	0603 100R 1%	R8 R10 R11 R12 R13	5	LED Lamp Scheme Application
15	SMT LED	0603 blue	D1 D2 D3 D4	4	
16	SMT LED	0603 red	D5	1	
17	SMT resistor	0603 100R 1%	R9 R10 R11 R12 R13	5	Digital Tube Scheme Application
18	Digital tube	YFTD1508SWPG-5D	SMG1	1	
19	LED	5MM LED	D6	1	
20	Inductor	10uH 7A R_{DC}<0.01R	L1	1	
21	KEY	SMT 3*6	K1	1	
22	SMT NMOS	R_{DS}<15mΩ, V_{DS}>30V, V_{GS}>12V, I_D>10A, C_{iss}<1200pF	Path NMOS	4	
23	Output USB	AF10 8 pins USB	USB1 USB2	2	
24	USB C	USB C connector	USB3	1	

|					
		connector			
25	Lightning connector	Apple lightning connector	USB4	1	
26	Input USB	MICRO-7-DIP-5.9	USB5	1	
27	SMT resistor	0603 20R 1%	R23	1	
28	SMT resistor	0603 3k 1%	R24	1	
29	SMT resistor	0603 510R 1%	R25	1	
30	SMT resistor	0603 10R 1%	R26 R27	2	
31	SMT MOS	$R_{DS}<10m\Omega$, $V_{DS}>30V$, $V_{GS}>12V$, $I_D>15A$, $C_{iss}<1200pF$	Power NMOS	4	
32	TVS	30V TVS	T1 T2	2	
33	SMT resistor	0603 2R 1%	R21 R22	2	
34	SMT capacitor	0603 2.2nF 10% 50V	C8 C9	2	

15 Package

15.1 Package of the Chip
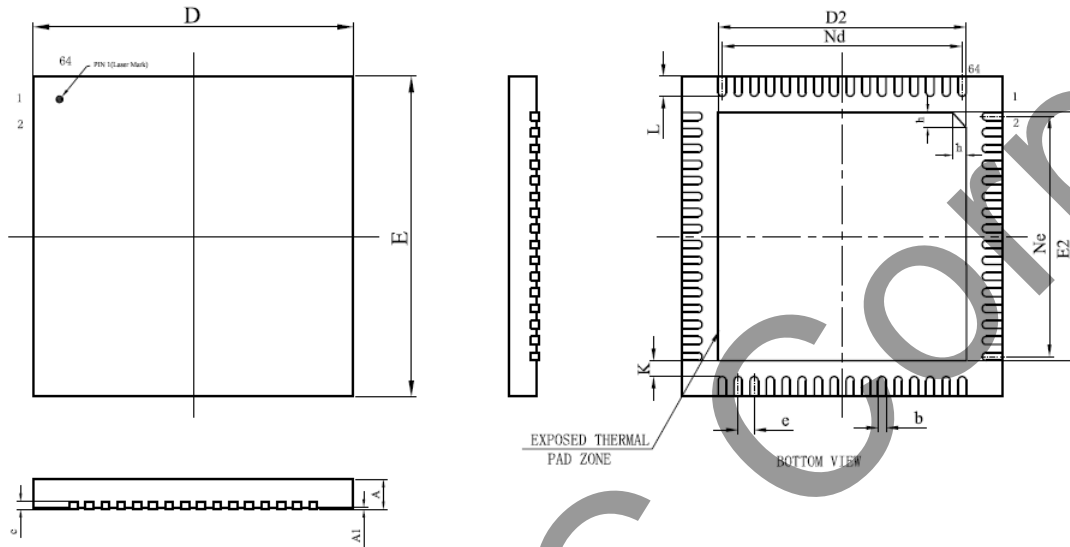
Figure 17　Chip package diagram

Table 23　Chip package various reference sizes

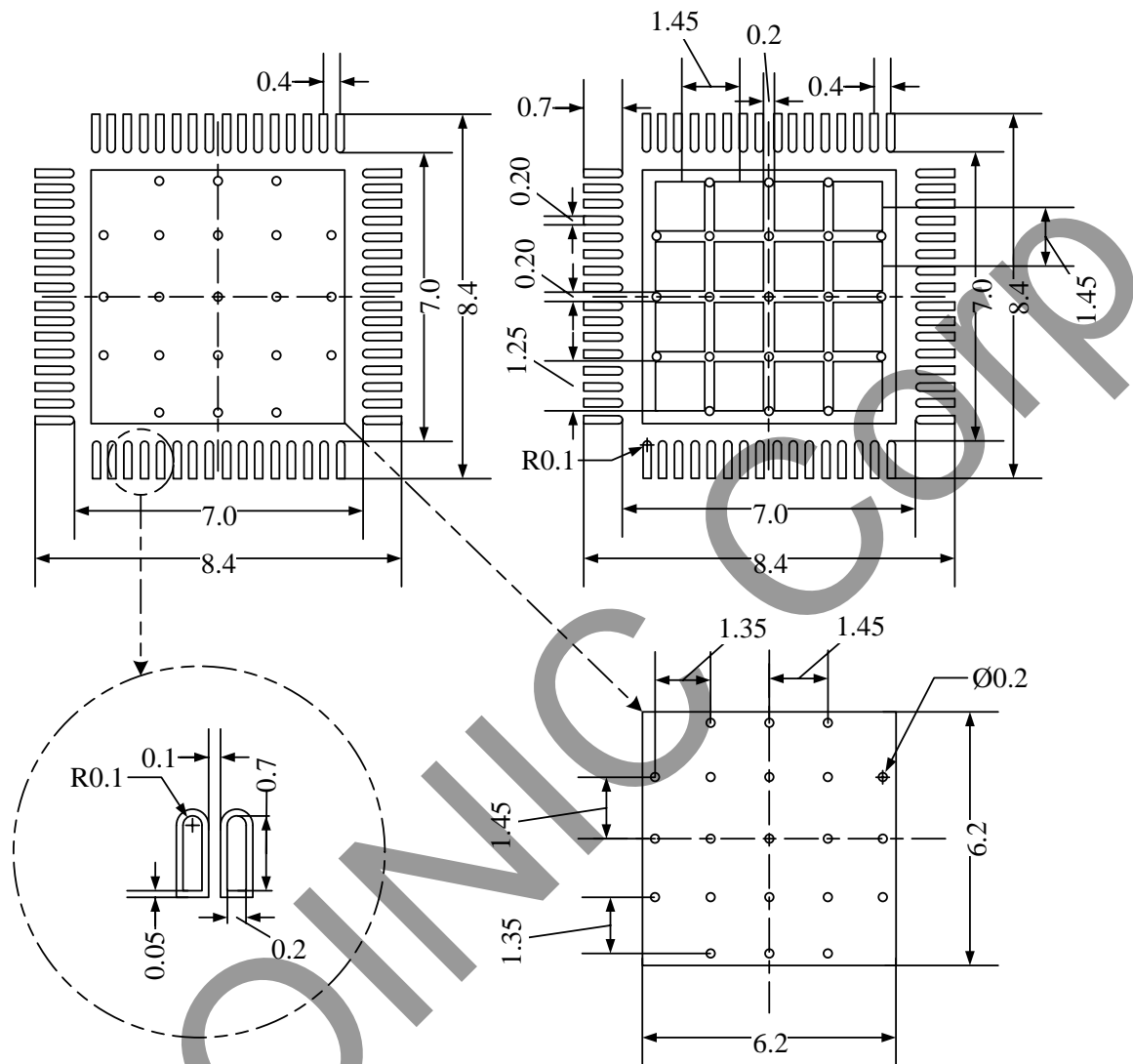| SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	-	0.02	0.05
b	0.15	0.20	0.25
c	0.18	0.20	0.25
D	7.90	8.0	8.10
D2	6.10	6.20	6.30
e	0.4 BSC		
Nd	6.00BSC		
E	7.90	8.0	8.10
E2	6.10	6.20	6.30
Ne	6.00BSC		
L	0.45	0.50	0.55
K	0.20	-	-
h	0.30	0.35	0.40

15.2 Pad design example

Figure 18   Pad design sample drawing

16 IC Printing description

16.1 Chinese Screen printing

说明：
1、 (j)   --英集芯标志
2、IP5389H --产品批号
3、XXXXXXXX --生产批号
4、 ○   --引脚1的位置标识

Figure 19   Chinese Screen printing

16.2 English Screen printing

说明：
1、 (j)   --Injoinic Logo
2、IP5389H --Part Number
3、XXXXXXXX --Manufacture Number
4、 ○   --Pin1 Location

Figure 20   English Screen printing

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